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Dear Dr. Lederberg,

(1) Muller never responded to Stern's critique of differential breeding. I suspect he never saw the article because Science and Society was a left wing publication and Muller in 1950 was hostile to most left wing periodicals. He felt out of sympathy with both Stalinism and Lysenkoism. From 1940-1955 Muller was largely silent on eugenics. He said that he still believed in it but that the trauma of Nazism made it virtually hopeless to discuss. After 1955 he felt a new generation would be willing to discuss eugenics.

(2) Muller criticized race theories in several articles while he was in the USSR (1933-37). For example, he lists "Genetics as opposed to the concept of pure races" (Russ.) Prog. Mod. Biol. 3:525-544. His displeasure with the milder racism and elitism of his colleagues is best seen in his Dominance of economics over eugenics (1932) and in his book Out of the Night. For his anti-Nazi views, his review of Human Heredity by Fischer, Baver, Lenz is readily available. The Russian articles have not been translated back to English and I was not able to locate the English originals among his manuscripts. See, too, Muller's "Geneticists' Manifesto" which he wrote and for which he solicited signatures at the 7th International Congress of Genetics, Edinburgh 1939.

(3) Muller's use of eugenics, at least from 1916 on, was at odds with the American eugenics movement. He believed there were inborn intellectual and behavioral differences among men and that these were not related to class or race. Most class distinctions, he felt, were environmental and thus the "inferiority" of lower classes was largely spurious. After 1955 Muller tried to rationalize the unequal opportunities in America as largely done away with (at least for whites) and thus his eugenic system seemed workable at a pilot level.


(4) I may have mentioned Ludmerer's Genetics and American Society which is very good on the "silence" of geneticists during the American eugenics movement and the passage of the Johnson Immigration Act.

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(5) Muller from 1930-32 was sympathetic to Communism. He put his energies and money in the editing and distribution of an underground paper "The Spark". Note that his anti-racism then was coupled with a pessimism that the U.S. could not solve this problem without a Socialist government.

I am also enclosing my review of Ludmerer's book and a more ambitious attempt to evaluate Muller's eugenics views some 5 or 6 years after his death. The references in it may be of some use for your project.

Sincerely yours,


Elov Axel Carlson
Professor of Biology

EAC/le

P.S. In my unrelated capacity as editor of the XIII Congress of Genetics Supplement volume, may I ask you if you intend to submit the speech you gave in the opening plenary session? I hope you do. Let me know when it will be available if you do want it in the supplement.

Modifying Man: Muller's Eugenics and Lederberg's Euphenics

Two recent volumes are records of symposia devoted to discussion and consideration of man's future and the way it is likely to be influenced, for better or for worse, by technological and scientific advances. Both include outstanding intellects—persons "who are thought to be sufficiently interesting to be invited from great distances." Both make very enjoyable reading; they are also important reading. They both carry a plea for more public awareness and discussion of the possibilities inherent in the tremendous advances in scientific knowledge, possibilities that may become realities soon enough to catch most of us by surprise. The two books are *Man and His Future* (Little, Brown, Boston, 1964, 416 pp. \$6), a Ciba Foundation volume edited by Gordon Wolstenholme, and *The Control of Human Heredity and Evolution* (Macmillan, New York, 1965, 141 pp. Paper, \$1.95), edited by T. M. Sonneborn.

The Control of Human Heredity and Evolution is the edited record of a symposium held on 6 April 1963, as part of the dedication of a new biology building at Ohio Wesleyan University. Organized by T. M. Sonneborn, the symposium reflects some of his personal characteristics. It stays close to the subject, it is well organized, the individual papers complement one another, and for the most part the discussion is disciplined and to the point. The main emphasis is on possible ways by which molecular and cell biology may be used to influence heredity, and on how soon this can be done and how practical it might be.

The new knowledge of molecular genetics and the possibilities offered thereby are presented by S. E. Luria and E. L. Tatum. This is followed by a discussion of human cell cultures by R. DeMars and G. Pontecorvo. There are several suggestions, some quite imaginative, as to how removal, addition, and replacement of genes might

take place through the application of methods that microbial genetics suggests may some day be feasible. Similar possibilities are offered for genetic intervention through manipulation of cells. Inventive and thoughtful contributions to the discussions are made by Kimball Atwood, George Klein, W. Szybalski, and Rollin Hotchkiss, who comment on biological possibilities and on the ethical problems raised thereby.

All such suggestions have one thing in common: they are not yet practical. In contrast to such future possibilities for genetic engineering, H. J. Muller develops his arguments for the application of artificial insemination as a eugenic technique. His paper begins with characteristic forthrightness: "The main thesis I wish to uphold in this paper is the following. For any group of people who have a rational attitude toward matters of reproduction, and who also have a genuine sense of their own responsibility to the next and subsequent generations, the means exist right now of achieving a much greater, speedier, and more significant genetic improvement of the population, by the use of selection, than could be effected by the most sophisticated methods of treatment of the genetic material that might be available in the twenty-first century."

Muller fears that too much discussion of such possibilities as cell transplants, DNA transformations, directed mutation, or suitably designed episomes may result in escapism and postponement and foster a "do nothing" attitude: "It would be intellectually dishonest and morally reprehensible of us to exploit the hope of mankind's eventual success in this enterprise as an excuse for not giving our support to the great re-educational process that could make possible, by means now physically available, a most significant advance in the genetic constitution of our species." Genetic engineering, if

it becomes practical, is most likely to be effective for traits determined by single genes, as is the case for many genetic diseases. But the hereditary component of many of the most important human traits—intelligence, general health, emotional stability, and disposition—is likely to be polygenic. The principle that like begets like is likely to be the best guide to prediction for some time to come, and selection the most efficacious means of genetic improvement. Muller's deep concern for human dignity and his belief that mankind can be willing to act responsibly in regard to its genetic future are apparent throughout, for example, when he registers his disagreement with "the stilling assumption that people would have to be forced, rather than inspired, to engage in any effective kind of genetic betterment."

Muller's thesis is also presented and discussed in the Ciba symposium volume *Man and His Future*. But here Joshua Lederberg brings out a contrasting view. Whereas the Ohio symposium dealt with molecular and cellular engineering versus selection in the control of genetic properties of future generations, Lederberg regards the real impact of molecular biology as being in the engineering of human development. Experimental modification of the developing human by physiological and embryological alterations has its effect in the same generation, not in future generations. Therefore, as such methods become applicable, they will have an immediate, not a long term, impact. Lederberg's view is that such possibilities can become real very soon. For developmental (as opposed to genetic) engineering, Lederberg proposes the term *euphenics*, and it is a measure of the impact of this book that the word has already come into general usage. In my view, Lederberg's euphenics and Muller's eugenics are not antithetical but complementary. Some traits may best be modified developmentally, others by selection.

Lederberg's and Muller's papers are both followed by considerable discussion of both the efficacy and the desirability of attempts to improve the hereditary endowment of future generations. It will come as no surprise that there was no great unanimity of opinion among the discussants.

The Ciba symposium volume includes many other topics. It begins with a paper by Julian Huxley on human evolution, the main thesis be-

ing that future human evolution will emphasize the psychosocial and cultural aspects. "In psychosocial evolution the struggle for existence has been replaced by what might be called the striving for fulfillment." Huxley gets the symposium off to a fine start, although I could do with less of Teilhard de Chardin and fewer neologisms (for example, psychedelics, teleonomic, noosphere, and psychometabolism).

The first problem discussed is that of the world food supply and overpopulation. John F. Brock describes some possibilities for more sophisticated diets that could support larger populations, though perhaps running counter to many people's gustatory preferences. Colin Clark repeats his familiar eccentricity of simply denying the existence of the problem. His view, as described by N. W. Pirie, is that "the world food shortage is really a figment of Boyd Orr's imagination." Needless to say, Clark gets very little support in the discussion. Gregory Pincus discusses new possibilities in chemical methods of birth control. Alan Parkes discusses the change in sex ratio at marriage ages being brought about by greater survival, which permits the neonatal male excess to be carried into young adulthood. He points out that "Women are beginning to have the scarcity value previously held by men" and wonders whether this might eventually lead to legal and religious recognition of polyandry.

Social groups, environmental pressures, and the impact of machines are discussed by Carleton Coon, Artur Glikson, and D. M. MacKay. There is the usual discussion of the limitations of machines ("can machines think") and of the effect of prediction of an event on the probability of its occurrence. I enjoyed J. B. S. Haldane's recipe for happiness in an increasingly sophisticated technological society: he simply migrated to India. "I could not keep up with modern technology, especially electronics, so I moved to a situation where the technology is at about the same level of development as it was when I was 20 years old."

The future of medical science, of infectious and malignant diseases, and of longevity are considered by A. Szent-Györgi, H. Koprowski, and Alex Comfort. Koprowski's essay is both thoughtful and poetic, a major theme being that the natural balance of microorganisms in the body should not be upset more than necessary. (Two of

his maxims: "Employ only vaccines which, while protecting against one pathogen, do not spread another"; "If a universal antibiotic is found, immediately organize societies to prevent its use. It should be dealt with as we should have treated, and did not treat, the atomic bomb.") The book maintains its high standard to the end with papers on human behavior and the mind by H. Hoagland and Brock Chisholm and a brilliant final essay, "Biological possibilities for the human species in the next ten thousand years," by Haldane.

I am usually skeptical of the value of publishing verbatim, or only slightly edited, reports of free-wheeling discussions. But in this case I often found myself reading the discussions with more interest than the prepared papers. The remarks were provocative, sometimes witty, occasionally trivial or irrelevant, but surprisingly often profound and original. Sometimes there were nonsequiturs as if the talking was too good for the listening. But it must have been exciting for the participants, and the reader of this volume is given a chance to share in the experience.

The ethical problems considered here are not entirely new. We have already

developed and use the techniques of blood transfusion, kidney transplants, and artificial heart valves. We are today confronted by serious ethical problems when lifesaving artificial kidney dialysis is available to only a small fraction of those who could be kept alive by this procedure. We have troublesome by-products of medical advances—drug-resistant bacteria and iatrogenic diseases. The scientific possibilities raised in this book do not alter the basic nature of these problems, but they do greatly magnify both the difficulties and the benefits.

The great value of these books is that they call to the attention of the public how real, how rapid, and how full of possibilities, for good and for evil, are the great transformations being brought about by modern science. It is good to know what some of our most sophisticated men say in their uninhibited discussions and speculations. To quote one participant: "Public information on the possibilities of human modification is not widely available or prevalent, particularly in the seats of high political power."

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